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MODELING THE IMPACT OF FOOD AID ON COMMERCIAL FOOD IMPORTS IN DEVELOPING COUNTRIES

Findings and Recommendations

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Findings and Recommendations

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The views and interpretations expressed in this report are those of the authors and should not be attributed to the Agency for International Development.

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EXECUTIVE SUMMARY

This study examined the feasibility of constructing and using an econometric model to estimate the relationship of food aid from specific donors to specific recipient countries. Specifically, the study investigated the desirability and feasibility of constructing such a model to estimate the impact of U.S. food aid to a specific country on U.S. commercial food exports to that country.

To complete the study, the Nathan Associates team

- Summarized the results of past research that attempted to reveal the impact of food aid on commercial trade of food products.
- Presented alternative econometric approaches for estimating the impact of food aid on commercial food imports, including a theoretical review of the linkages between food aid and commercial food imports.
- Discussed one noneconometric approach for studying the impact of food aid on imports; and
- Recommended the preferred approach for examining these linkages.

The study also examined the feasibility and desirability of constructing an econometric model to estimate the impact of food aid on commercial food imports from the United States. This chapter summarizes the study's findings and recommendations.

Findings

Past research by Nathan Associates reviewed all quantitative studies examining the impact of food aid on commercial trade and found no single research effort that isolated the long-term impact of food aid on commercial trade. Therefore, the team reviewed the theoretical determinants of food aid's impact on commercial trade and surveyed the availability of necessary data for conducting an econometric study of food aid linkages for important food aid recipient countries.

From the results of this initial investigation and a discussion of the relative merits of econometric modeling methodologies, the team formulated three possible modeling approaches for examining food aid linkages. The study found three alternative econometric approaches and one noneconometric approach to be appropriate for analyzing food aid linkages. The econometric approaches include a structural model, a transfer function model, and a vector autoregression model. Country studies were found to be a useful noneconometric approach for examining food aid linkages for key food aid recipient countries. For both the transfer function and vector autoregression approaches, the study found that 17 food aid recipient countries could be examined, based on the availability of data. The structural model, however, could be completed for only a handful of food aid recipient countries. In addition to these econometric approaches, the team found that detailed country studies, although not useful for producing generalizable results, would, however, reveal the critical institutional and policy mechanisms that govern the transformation of food aid into commercial trade. Country studies would provide useful policy-level guidance for future food aid programming.

Recommendations

In view of the alternative approaches for examining this question, the study recommended the vector autoregression approach as the best econometric technique for analyzing the impact of food aid on commercial imports. This approach was recommended because it (1) tests the dynamic interactions among the variables that affect imports, (2) contains a separate equation for each endogenous variable and can capture the indirect effects of food aid on imports through the impact of food aid on other variables, (3) captures the dynamic interactions among the endogenous variables that might affect food imports, (4) is feasible to construct because the data requirements can be satisfied, and (5) uses software that is user friendly and facilitates rapid analysis of the data.

The study recommended that an econometric examination of food aid linkages be conducted in tandem with detailed country studies. The study concluded that the ideal method was to run a vector autoregression model to identify linkages between food aid and commercial food imports and use selected case studies to further explore why these linkages exist.

Chapter 1

INTRODUCTION

The impact of food aid on recipient country production has received substantial attention in the development literature. Many studies have also addressed the impact of food aid on commercial food imports. The literature review completed by Nathan Associates (1990) revealed that few studies have directly addressed the long-term ramifications of food aid on U.S. commercial imports in recipient countries. Moreover, the Nathan Associates study found no studies that used econometrics as the primary methodology of analysis to measure or identify the long-term linkage between food aid imports and commercial trade. Therefore, the U.S. Agency for International Development's (A.I.D.) Bureau for Food for Peace and Voluntary Assistance wanted to determine whether the impact of food aid on commercial trade in agricultural commodities can be measured through econometric techniques, and if so, to examine alternative specifications and to determine whether one or more models could be developed that would give meaningful statistical results.

The results of the study are presented in this report. The study was conducted by a four-person team from Nathan Associates. The team consisted of a senior staff member who served as the project manager, an econometric expert, and two staff researchers. The complete scope of work is presented in Appendix D.

Chapter 2

BACKGROUND

The legislation governing U.S. food aid emphasizes both trade promotion and development assistance as objectives of the food aid program, while recognizing the need to avoid negative effects on either the recipient country's agriculture or the donor country's commercial trade. Despite more than three decades of experience with food aid, the program's impacts on the recipient country and on international trade—both positive and negative—remain controversial and have been a continuing focus of attention both among academics and within the development community.

This interest on the part of academics and the development community led to the development of a substantial and diverse literature on food aid. There have been numerous reviews of food aid literature, including the synthesis of more than 80 A.I.D. evaluations of program food aid completed in 1989 by Nathan Associates Inc.[1] Despite this interest, few systematic attempts have been made to assess the impact of food aid on commercial trade, whether in the short-term or the long-term. Because the impact of food aid on commercial trade is the subject of continuing controversy, most reviews of the food aid literature address this issue (see, for example, Maxwell 1983, Clay and Singer 1985, and the Nathan Associates' 1989 review of A.I.D.'s food aid evaluations), but the broad scope of these studies prevents them from examining the issue systematically.

Despite thousands of studies, articles, and reports that have evaluated the effectiveness of food aid programs, the nature of the impact of food aid on commercial trade and development remains unclear. A study conducted by

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[1] Jennifer Bremer-Fox and Laura Bailey. *The Development Impact of U.S. Program Food Assistance: Evidence for the A.I.D. Evaluation Literature.* Nathan Associates Inc. for the U.S. Agency for International Development, Washington D.C., 1989.

Nathan Associates Inc. in 1990,[2] under a contract from A.I.D.'s Bureau for Food for Peace and Voluntary Assistance, reviewed 24 studies that used quantitative analytic methods to explore food aid impacts on the recipient country's commercial trade.

The 1990 Nathan Associates study focused primarily on studies that have sought to measure or verify, on the basis of rigorous analysis of historical data, the relationship between food aid and commercial food imports. However, no quantitative studies were identified that attempted to confirm analytically the relationship between food aid and commercial trade in the Asian cases that are frequently cited as evidence of such a relationship (Korea and Taiwan). A second major gap in this literature is the failure of some studies to distinguish adequately among project, program, and emergency aid in measuring impacts.

Seventeen of the studies attempted to quantify the relationship between food aid and commercial food imports, whereas the remaining studies used less rigorous analysis of other variables to draw conclusions about impacts on commercial trade. With the exception of four studies on India and one on Colombia, all of the studies conducted alternative analyses of the same data or reported analyses from several countries. Estimates were obtained from a total of 17 single-country and 3 multi-country studies (excluding studies that reported coefficients on food aid that were not statistically significant).

The remainder of empirical evidence produced by these studies confirms that, in some cases, food aid partly displaces commercial food imports, at least in the short term. This finding is generally supported by a plurality of the studies on the basis of analysis of data by country. Six of the 17 single-country analyses that directly measured this impact[3] found that each ton of food aid displaces between 300 and 900 kg of commercial food imports in the short term, and 5 found smaller displacement impacts.[4] However, these findings provide ambiguous results. The three studies that

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[2]Jennifer Bremer-Fox, Laura Bailey, and Mary Mervenne. *Food Aid Impacts on Commercial Trade: A Review of the Quantitative Evidence.* Nathan Associates Inc., for the U.S. Agency for International Development, Washington D.C., 1990.

[3]Clay's estimates two for Sri Lanka, Hall's estimates for Brazil and Colombia, one of Maxwell's estimates for Ethiopia, and Mann's estimate for India.

[4]Bolling's estimates for Jamaica and Trinidad, Rogers' estimate for India (also reported in Srivastava), Shapouri and Rosen's estimate for the Sudan, and Rosen's estimate for Madagascar.

pooled data from several countries revealed a positive relation between food aid and commercial food imports in the short term, as did six of the country studies.[5]

The findings appear to cluster in two groups. In the first group are countries in which food aid accounts for a relatively minor share of total availability (e.g., India and Brazil). Studies for these countries generally revealed substantial displacement of commercial food imports. A second group consists of countries in which food aid is a major source of both imports and total grain availability (primarily African countries). Studies for this second group tend to reveal a minor impact on commercial imports, either positive or negative, possibly suggesting that the income effect (increasing total imports) is outweighing the price effect (discouraging commercial food imports). This conclusion is appealing intuitively but should not be considered definitive. The wide variation in the coefficients estimated and the low degree of statistical significance in many of the analyses suggest that coefficient estimates are sensitive to model specification.

A second major conclusion supported by the literature is that the short-term impact of food aid on commercial food imports depends on the design of the program and on the structure of the food market in the recipient country, both of which are in turn greatly influenced by the domestic policy environment in the recipient country. In particular, programs that direct food aid through channels that do not directly compete with the commercial market are less likely to displace commercial imports than are food aid programs that more closely resemble commercial imports in their design and operation. Because programs operating outside commercial channels generally provide food at below-market prices, they have the potential to increase demand through income transfer effects, as well as through simple price effects. This impact is directly related to the use of below-market-price channels, an approach that is being phased out in a number of countries and one, moreover, that is less likely to translate into increased commercial sales over the longer term (because of the inability of the recipient to continue the program without concessional financing). Given the importance of the demand side on the food system, models that incorporate market duality where it exists tend to perform better than those that examine only the supply side.

The findings of the single-country analyses on short-term trade impacts are contradicted by the three multi-country studies. The studies that combined data from several countries generally found a positive relationship between food aid and commercial food imports. Although further analysis is needed to explain the result in light of the country work, it appears that the

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[5]Maxwell's second estimate for Ethiopia; Rosen's estimate for the Sudan; Shapouri and Rosen's estimates for Liberia, Senegal, and Mali; and Bezuneh's estimate for Tunisia.

result captures inter-country differences in food self-sufficiency (overall import needs) rather than any connection between food aid and commercial trade as such. In other words, looking across countries, large quantities of food aid and large commercial food imports tend to occur in the same countries: those with a large food deficit are more likely to import greater quantities commercially and to receive large amounts of food aid.

Food aid's long-term impact on commercial trade development, including its effectiveness as a tool for expanding U.S. markets for agricultural commodities, have in general not been examined. No studies were found that attempted to link food aid to commercial food import levels more than 3 years later or to match food aid donations with increased sales or donor market share (short term or long term). Thus, the studies available do not address vital issues such as whether food aid "graduates" are more or less likely to import commercially, whether food aid recipients are more likely to become better commercial customers for the donor country (in terms of absolute levels or market share), whether food aid has a measurable impact on the commodity mix imported over time, or whether food aid recipients are more or less likely to increase their reliance on external trade rather than on domestic production for their basic food supply. A possible explanation for the lack of analysis on these issues might be that there is more interest in food aid's impact on possible production disincentives, rather than on trade, whereas analysts interested in trade impacts have preferred to focus on pure trade interventions, such as the Export Enhancement Program.

The quantitative studies conducted to date underscored the need to look more quantitatively at the impact of food aid. Approaches presented in Chapter 3 attempt to meet these shortcomings.

Chapter 3

ALTERNATIVE APPROACHES

Food Aid and Commercial Food Imports: Causal Linkages

The linkages between food aid and commercial food imports are numerous and complex. Figure 1 illustrates some of the potential linkages between food aid and commercial food imports. The direct and indirect transmission mechanisms between food aid[6] and commercial imports (see Figure 1) are discussed next.

Food aid has a direct effect on imports. In many countries, food imports are controlled by the government. Food imports are often seen as a supplement to domestic production; they satisfy excess demand. Therefore, food aid may have a "substitution effect" on commercial food imports because governments substitute food aid for commercial imports. This relationship is shown in Figure 1 as a direct arrow between food aid and commercial food imports. Also, food aid may have a long-term effect on commercial food imports, if the food aid helps to change preferences. Many other factors may affect preferences for the imported product, for example, urbanization and income growth. In fact, food aid may help to change preferences indirectly, inasmuch as it contributes to income growth and the urbanization that historically accompanies income growth.

Food aid also has a direct income effect because it represents a transfer of resources to the recipient country. The transfer can occur through many different channels. For example, when the food aid obtained by a

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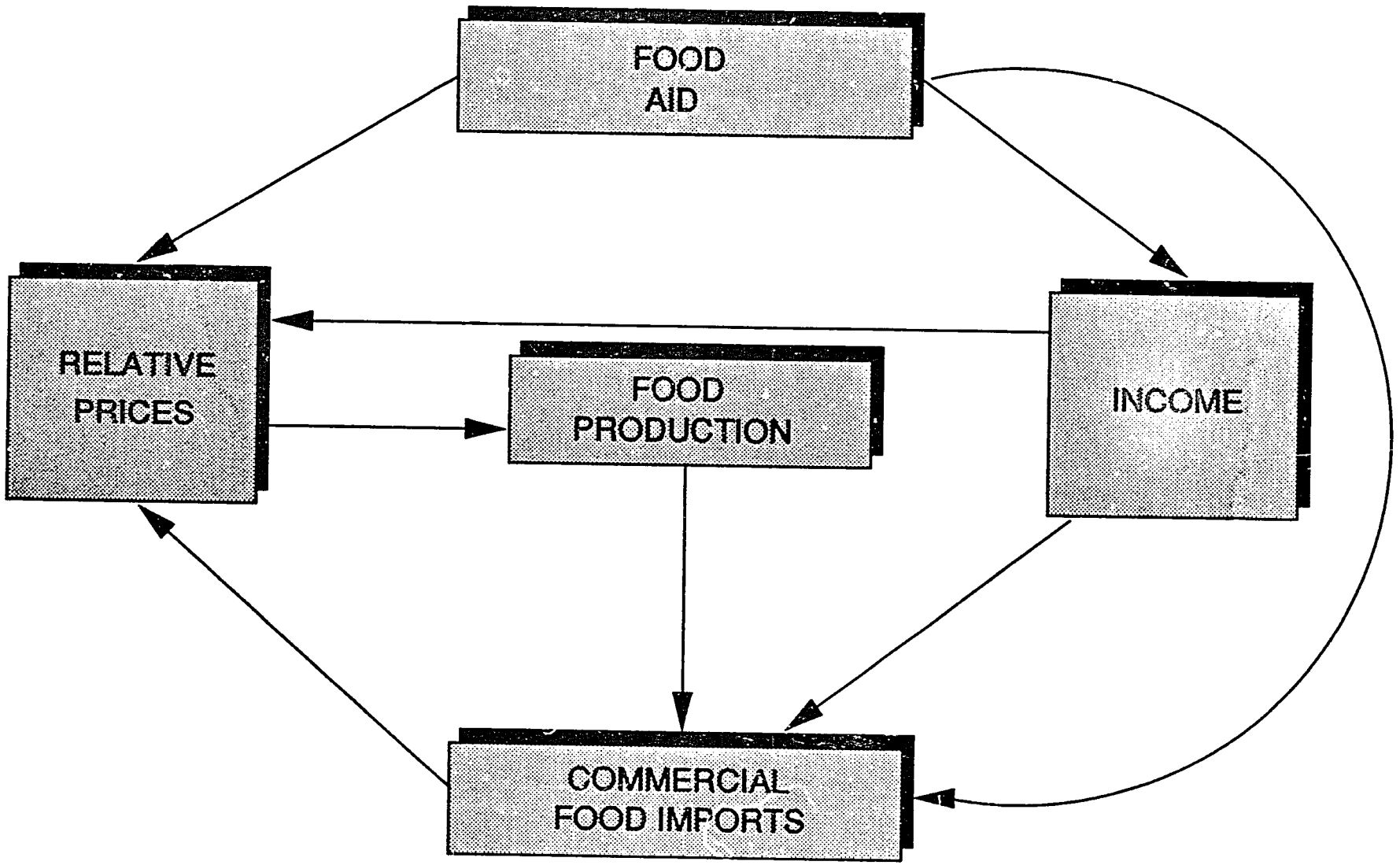
[6]Food aid refers to the transfer from donor to recipient country of a specific amount of a commodity. This commodity is valued at its market price in U.S. dollars and can be measured as either Title I (concessional sales) or Title II (food aid grants). All other variables are measured in terms of real U.S. dollars.

Figure 1. Linkages Between Food Aid and Commercial Food Imports



recipient country is sold by its government on the open market, the government may use the proceeds for additional spending. Because food aid transfers resources to the recipient country, the disposable income of that country is believed to increase.

The transfer effect of food aid on income is shown in Figure 1 by the arrow connecting food aid and income. Because a country spends a portion of its income on commercial food imports, higher income may lead to higher food imports (Figure 1). This relationship is shown by the arrow linking income and commercial food imports. During the time period when the food aid is received, this income effect may not be sufficient to offset the substitution effect of food aid, whereby food aid replaces commercial food imports. Whether food aid substitutes for commercial imports depends on whether food aid is an acceptable substitute for commercially imported commodities. If a country prefers rice, for example, but is given wheat, its imports of rice may actually increase as a result of the income effect of food aid. If the country strongly prefers wheat, and is given wheat, its commercial imports of wheat may decline. Thus, the strength of these short-term substitution and income effects is dependent on the country's preferences for the food aid commodity.

Food aid may also have a long-term impact on income, which may have long-term consequences for commercial food imports. For example, if food aid generates foreign exchange for critical imports such as capital goods, then food aid may lead to substantial increases in income in subsequent periods. Some of this increased income may then lead to greater food imports, especially if the income increase accrues primarily to lower income families who often devote most of their income to food purchases, and especially in middle income countries undergoing a transition in consumer preferences from grains to meat. In this case, the long-term impact of food aid on commercial food imports is positive.

Food aid may also have an impact on domestic food production. The impact of food aid on domestic food production is ambiguous because the impact of food aid on the price of food (and hence domestic production of food) is uncertain. Food aid may potentially affect both supply and demand for food, thus having an ambiguous impact on price. Because food aid increases income, it shifts the demand curve for food to the right, leading to higher food prices. This connection is represented by the arrow connecting income and relative prices in Figure 1. Higher food prices should entice producers to increase production; the higher prices should be thought of as moving producers up along the supply curve.

Food aid may or may not affect the supply curve for food, depending on the extent to which food aid replaces commercial food imports. Assuming that food aid does not totally replace commercial imports (and hence increases total food supply), an increase in food aid initially will shift the supply curve of food to the right, putting downward pressure on price.

Whether increases in food aid have a long-term or transitory impact on food supply depends on the long-term response of domestic producers to the decline in food prices. If food aid initially increases food supply and depresses food prices, domestic producers may cut back on food production in subsequent periods in response to these lower prices. This, in turn, may decrease total food supply so that food aid has no net impact on food supply in the long-run; instead, food aid simply substitutes for domestic production over the long-term.

In summary, the impact of food aid on domestic food production is ambiguous, depending on the relative strengths of the shifts in food supply and demand elicited by increased food aid. Consequently, this issue is widely discussed in the literature; for example, see Mann, 1967; Rogers et al., 1972; Bezuneh and Deaton, 1983.

Many governments use commercial imports to supplement domestic production. The changes in relative prices induced by food aid may therefore have an impact on commercial food imports. If governments calibrate their food aid imports to domestic production, changes in domestic production may lead to alterations in commercial food imports. This is illustrated by the arrow linking food production and commercial food imports (Figure 1).

Note that feedback also occurs between imports and relative prices (Figure 1). If food aid simply replaces commercial food imports, leading to no change in domestic food supply, then domestic prices may remain unchanged. In fact, with the income effect of food aid increasing food demand, food prices may even increase (Lavy, 1990).

Before possible modeling approaches are presented, the following additional issues related to modeling food aid linkages are discussed.

- Time series models versus cross sectional models,
- Methodologies to assess the differences in response across countries, and
- Additional variables that measure resource efficiency and export orientation.

These issues are addressed next followed by a presentation of three modeling approaches.

Time Series Models Versus Cross Sectional Models

The models outlined in this chapter involve a time series analysis, where the unit of analysis is a single country and its experience with food

aid and commercial food imports over a number of years. The alternative to a time series model is a cross sectional model, where data for several countries are analyzed for a given year. The problem with the cross-sectional approach is that it cannot capture the dynamic interaction between the variables; for example, it cannot capture the impact of a change in food aid in one period on changes in commercial food imports in successive periods. Given the difficulty with constructing a sufficiently long time series for some countries, a common econometric technique is to pool the data for several countries over fewer years. In his paper on food aid and production, Lavy (1990) used data from 33 African nations for the years 1970-1987. This approach is not recommended because pooling the data (1) does not permit a comparison of results among countries; and (2) imposes a common structure across all countries. More details on the specific characteristics of a pooled model are discussed in Appendix B, which outlines a model using pooled data to assess the impact of food aid on commercial food imports from the United States.

Methodologies to Assess the Differences in Response Across Countries

The models presented in this chapter are capable of measuring the impact of increased food aid on commercial imports for a given country. Once the model for a number of different countries is estimated, researchers may inquire as to why the results of the model differ from country to country. In this context, two hypotheses are of interest: (1) food aid has a positive impact on commercial food imports over the long run, but only insofar as the recipient country uses its resources, including food aid, in an efficient manner; and (2) the positive impact of food aid on commercial food imports is strongest in those countries that adopt export-oriented development strategies.

The methodology for testing these hypotheses is correlation analysis. Correlation analysis involves several steps. First, results from the model for several countries—at least 15 to 20—must be collected. The model will estimate a single variable that measures the responsiveness of commercial food imports to increases in food aid. One proposed model approach will measure the impact of a unit increase of food aid on commercial food imports. For each country, this variable is obtained, showing the responsiveness of a unit increase in food aid on commercial food imports.

The next step is to find variables that demonstrate (1) the efficiency of a country in using its resources (to test Hypothesis 1); and (2) variables that show the degree of export-orientation of an economy (to test Hypothesis 2). When the variables measuring efficiency and export-orientation are found, then Pearson product-moment correlation coefficients between the variables can be calculated to ascertain whether any statistically significant relationships

exist. Specifically, one should look for the relationship between variables measuring import response to increased food aid and variables measuring efficiency and export orientation. For example, if efficiency has an impact on the responsiveness of commercial food imports to food aid, this will be revealed by a positive and statistically significant correlation coefficient between variables measuring import response and efficiency.

Variables That Measure Resource Efficiency and Export Promotion

It is recommended that a country's resource efficiency and export orientation be included in an examination of the linkage between food aid and commercial food imports. Thus, these variables should be constructed and incorporated into the model. The rationale and methodologies for constructing and incorporating these variables into the model are presented below.

Resource Efficiency

The team proposes using the investment to gross domestic product (I/GDP) ratio as a measure of the degree to which a country uses its resources for future growth. This variable was chosen to measure efficiency because it measures the amount of the resource transfer through food aid that will be invested in the year it is received. Countries with high I/GDP ratios can be expected to have greater long-term growth than those with lower ratios, because those countries are willing to sacrifice current consumption for higher living standards in the future. The average I/GDP ratio for the years used in the VAR model are proposed.

By itself, however, the I/GDP ratio does not reflect how efficiently an economy produces output with its given resources; rather, it is a measure of how much a nation is willing to save and invest. Hence, we propose using an additional measure of investment efficiency, the incremental capital/output ratio (ICOR). This ratio shows the amount of extra output created per unit of investment. An interactive term can also be formed that combines both the I/GDP ratio by the ICOR, an output gain variable. This variable is measured by multiplying the reciprocal of the I/GDP ratio by the incremental capital/output ratio. This output gain variable shows not only how much of the income in a given year is invested (I/GDP), but also how much this extra investment might be expected to increase output.

Another efficiency variable that can be used is the World Bank index of distortions, which shows how much prices in a country deviate from the levels that would prevail under competitive market conditions. One problem with the distortions index is that it is available for one time period only, the 1970s. Hence, if this index is used to measure distortions from 1955 to the present, it must be assumed that the level of distortions (or at least the

ranking of countries by their level of distortions) during this time period is adequately represented by 1970s data. Although this assumption may appear to be unreasonable, it should be noted that this index was used by Lindert (1986) to explain economic performance for time periods that included years outside the 1970s.

Export Orientation

Several variables are proposed to measure export orientation: (1) the average level of exports as a share of GDP; (2) the average export growth rate; and (3) the average value of export growth rate divided by the average growth rate of GDP. These measures provide a picture of the role of exports in a country's development strategy. The averages will be calculated for the years used in the vector autoregression model.

U.S. Food Imports

Note that the linkage between food aid and total commercial food imports is examined rather than total commercial imports from the United States. The impact of food aid on commercial imports from the United States depends on the United States' share of a country's commercial food imports. The U.S. share depends on the price competitiveness of U.S. food exports. It is possible to draw important insights from models relating food aid to all commercial imports, even though the impact of food aid on U.S. imports is not modeled.

The crucial question is whether food aid created additional demand for commercial food imports. Whether the United States captures this additional demand depends on the price competitiveness of U.S. exports. Therefore, a model relating food aid to all commercial food imports can provide valuable insights into the U.S. case because the results from such a model indicate whether food aid helps to expand commercial food markets abroad for food exporters.

Although it may be of interest to examine the impact of food aid on commercial food imports from the United States for a particular country, the available data are not sufficient for modeling this relationship. According to the U.S. Department of Agriculture's (USDA) Economic Research Service (ERS), data on U.S. exports by commodity to individual countries are only available from 1969 to the present. An insufficient number of observations (20) are available for constructing a time series model relating food aid and commercial food imports from the United States for specific countries. However, country data could be pooled to increase the number of observations. Thus, instead of examining the impact of food aid on U.S. commercial food imports to each country, the impact of food aid on U.S. commercial food imports of all recipient countries could be examined. Pooling the data in order to examine food imports solely from the United States is

not recommended, however, because it (1) precludes any comparison across countries; and (2) forces the assumption of a common structure for the model across all countries. Nonetheless, Appendix B presents a model specification for pooled data that focuses exclusively on food imports from the United States. The level of effort necessary to calculate this model is also discussed in Appendix B.

Alternative Modeling Choices

To appropriately model the impact of food aid on commercial food imports is a complex task. Three alternative approaches are described in this section: (1) a structural model, (2) a transfer function model, and (3) a vector autoregression model.

One approach taken in the literature has been to simply estimate import demand functions when imports are a function of income, relative prices, domestic production, and food aid. The problem with this single-equation approach is that food aid, as an exogenous variable, has an impact on the other exogenous variables, such as domestic production and income. To overcome this problem, researchers have typically used multi-equation "structural" models. The merit of this approach is that it captures the interactions between food aid, domestic production, and income, which in turn have an impact on imports. The structural model is described next.

Structural Model

The model used by Bezuneh and Deaton (1983), which closely parallels the approach of Mann (1967) is used here for expository purposes. The model involves the following equations:

$$QS_t = f(P_{t-1}, YA_t) \quad (1)$$

$$QD_t = f(P_t, Y_t) \quad (2)$$

$$Y_t = f(QS_t, QI_t) \quad (3)$$

$$M_t = f(QS_t, AID_t) \quad (4)$$

$$QD_t = QS_t + M_t + AID_t \quad (5)$$

where

QS_t = per capita quantity produced (supplied) of food by domestic producers in time period t,

P_{t-1} = price of food in time period t-1,

YA_t = yield per acre,

QD_t = per capita quantity demanded in time period t,
P_t = price of food in time period t,
Y_t = gross domestic product per capita in time period t,
QI_t = quantity of industrial goods produced in time period t,
M_t = per capita commercial food imports in time period t,
P_t = price of food in time period t, and
AID_t = per capita food aid in time period t.

Equations 2 through 5 must be solved simultaneously. In Equations 1 through 5, some variables on the right are also on the left. Although Equation 1 can be estimated by ordinary least squares, the rest of the equations must be estimated simultaneously by two-stage least squares (2SLS) or three-stage least squares (3SLS).

Once parameters are obtained for the variables, the impact of a unit increase in food aid can be simulated. The model detects if food aid substitutes for commercial food imports (Equation 4). Food aid may also have an impact on commercial food imports through its impact on prices. Food aid may result in a change in food prices (P) through Equation 5. As food aid increases total food supply, it shifts the supply curve to the right, depressing price. Moving down the demand curve, quantity demanded of food increases in response to the increased supply. This decline in price may lead to a decline in domestic production in the following period, as Equation 1 detects the impact of a fall in price in period t-1 on production in period t. Because falling prices represent an increase in per capita income for consumers, the demand for food increases (Equation 3). Thus, the impact of food aid on prices is ambiguous.

As indicated previously, there are shortcomings in this approach. Reliable results (defined below) must be achieved for each equation before any confidence can be placed in a structural model. Care must be taken to accurately model any government intervention in markets. Carefully constructed structural models that account for government intervention, such as Hall (1980) for Brazil, Abbott (1979) for Egypt, and Scobie (1981) for Egypt, involve numerous equations and in-depth knowledge of institutional details of how prices are determined in each country. This approach is not invalidated by the difficulties, but it is more time-consuming and risky than other approaches, such as vector autoregression, discussed below. That is, without specific knowledge of how prices are formed, correct variables or equations may not be incorporated into the model, leading to model misspecification. If a model is misspecified through failure to include relevant variables, poor statistical results may be obtained (low R-square, insignificant coefficient

estimates). Even if a misspecified model produces good statistical results, these results cannot be used for hypothesis testing (Judge et al., 1985).

Another drawback to the structural approach used in past studies is its failure to capture all the dynamic interaction that may exist between variables. This dynamic interaction is captured by including lagged endogenous variables. The dynamic interaction of income with imports is most important in this respect. An increase in food aid in period *t*, given that it leads to increased income in subsequent periods (through savings and investment undertaken in period *t*), may lead to an increase in commercial food imports. The structural models constructed to date have ignored the dynamic impact that food aid may have on income and, hence, on commercial food imports. The impact of price changes on production may also occur with a lag. Other approaches, such as vector autoregression, test for the appropriate lag structure, ensuring that these dynamic effects are not ignored. A second possible modeling approach, transfer function modeling, is presented next.

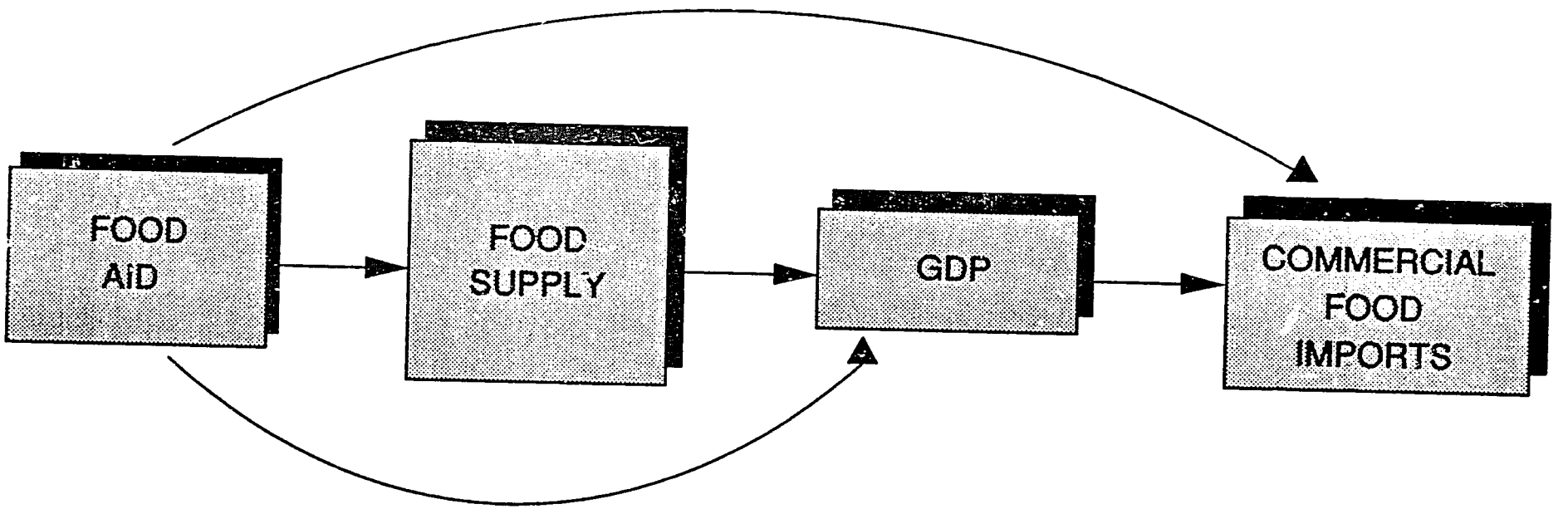
Transfer Function Model

When the transfer function model is used, causality is assumed to run in a one-way direction among the variables. The direction of this causality is shown in Figure 2. Food aid is assumed to affect domestic food supply (defined as the sum of food aid, commercial food imports, and domestic production). Food aid increases domestic food supply (FS), therefore an increase in food aid releases resources for other uses in the economy. This increases income (GDP), as shown by the arrow connecting FS and GDP (Figure 2). Even if food aid does not affect food availability (e.g., if food aid simply substitutes for commercial food imports), it still releases resources; thus, it still may increase GDP, as shown by the arrow connecting food aid (AID) and GDP. If AID affects GDP with a lag, it will be captured by the transfer function model. Increased income is assumed to lead to greater imports, as shown by the arrow linking GDP and commercial food imports (M) in Figure 2. AID may substitute for commercial imports in the immediate time period as shown by the arrow directly connecting AID and M.

Transfer models are a technique based on the Box-Jenkins time-series approach, generally referred to as univariate autoregressive integrated moving-average (ARIMA). In univariate ARIMA models, past values of a given variable are used to forecast its present and future values. The model builder must try to identify patterns in the data and determine whether the past pattern moves in an autoregressive or moving-average fashion. ARIMA models are simply fancy correlation models in which past values of a variable are correlated with other past values to identify some pattern in the data.

For example, an ARIMA model can be used to examine past patterns in the variations of GNP during the past 20 years in order to help forecast future values of GNP—without adding any insights from other variables.

Figure 2. Causality Between Food Aid and Commercial Food Imports



Transfer function models are multivariate ARIMA models. In a univariate model, for example, the current value of imports is predicted on the basis of past values of imports. In a transfer function model, the current value of imports is predicted as a function of current and past values of other variables, such as food aid. The difference between transfer functions and structural models is that the transfer function is much better suited to capture the lagged impact of food aid on commercial food imports. The output from a transfer function model will yield estimated coefficients and *t*-statistics that assess whether food aid has a statistically significant impact on commercial food imports.

In order to assess the impact of food aid on commercial food imports, one should measure whether food aid helps to explain any of the movement in the import time series. A transfer function relating commercial food imports and food aid will not suffice because other variables, such as income and domestic food production, may also affect the import series. Also, income cannot simply be added as a variable in a transfer function model because food aid affects income as well. However, transfer function modeling isolates the impact of food aid on income and production, creating an income variable that is free from the impact of food aid on income. This residual variable can then be added as a control variable in the transfer function model.

The steps involved in running the transfer function model are as follows:

1. Estimate the structure of the univariate time series of imports (M).

2. Estimate the bivariate transfer function, M = f(AID).

3. Estimate the structure of the univariate series food supply (FS).

4. Estimate the bivariate transfer function FS = f(AID); retain the residual series, FS'. FS' is a cleansed version of FS; it shows movements of the time series FS when the impact of food aid is removed.

5. Estimate the structure of the univariate series for GDP.

6. Estimate the bivariate series GDP = f(FS).

7. Estimate the trivariate transfer function, GDP = f(AID, FS'); retain the residual series GDP.

8. Finally, estimate the four-variable transfer function, M = f(AID, FS', GDP'). The coefficient on AID will measure the impact of AID on food imports. A *t*-statistic can be computed to address whether food aid has a statistically significant impact on imports.

Note that the channels through which food aid affects commercial food imports can be seen in the Steps 1 through 7. If food aid has a direct effect on GDP, independent of its impact on food supply, the effect will be captured in Step 7. In Step 8, the coefficient of AID will assess the impact of AID through both income, substitution, and market creation effects. As defined previously, the substitution effect refers to the tendency of food aid to replace commercial food imports, whereas the market creation effect refers to the ability of food aid to increase demand for food by increasing incomes in the recipient country.

It is possible to construct a transfer function model to examine the linkage between food aid and commercial food imports because sufficient degrees of freedom exist (15 to 20) to estimate the model for each country. In addition, transfer function models require fewer variables on the right than do vector autoregressive models (VAR). However, transfer models do not detect feedback effects among endogenous variables, which forces the researcher to assume that cause and effect relationships among the variables are in only one direction. A third possible model approach (VAR) that can overcome this constraint of the transfer function model is presented below.

Vector Autoregressive Model

In view of the difficulties with structural and transfer function models, it is suggested that a vector autoregressive model be used. Autoregressive means that past values are incorporated from the time series of the endogenous variable to help explain itself. Vector autoregressive means that past values of other endogenous variables are also used to help explain or forecast the movements in a given variable. For example, movements in commercial food imports from the United States (M) are forecast from past values of imports and past values of income and food production.

How vector autoregression captures the linkages between these variables is that, like a structural model, equations for each of the endogenous variables are estimated. However, unlike a structural model, the variables on the right of the equation are always the same, regardless of the variables on the left. Unlike a structural model, a VAR model captures the lagged effect that changes in one endogenous variable may have on other endogenous variables.

The model proposed is the following:

$$M_t = f(\Sigma_{n=1}^{n} M_{t-n}, \Sigma_{n=1}^{n} Y_{t-n}, \Sigma_{n=1}^{n} QS_{t-n}, \Sigma_{n=1}^{n} AID_{t-n}, PM_t, FXR_t) \quad (6)$$

$$Y_t = f(\Sigma_{n=1}^{n} M_{t-n}, \Sigma_{n=1}^{n} Y_{t-n}, \Sigma_{n=1}^{n} QS_{t-n}, \Sigma_{n=1}^{n} AID_{t-n}, PM_t, FXR_t) \quad (7)$$

$$QS_t = f(\Sigma_{n=1}^{n} M_{t-n}, \Sigma_{n=1}^{n} Y_{t-n}, \Sigma_{n=1}^{n} QS_{t-n}, \Sigma_{n=1}^{n} AID_{t-n}, PM_t, FXR_t) \quad (8)$$

$$AID_t = f(\Sigma_{n=1}^{n} M_{t-n}, \Sigma_{n=1}^{n} Y_{t-n}, \Sigma_{n=1}^{n} QS_{t-n}, \Sigma_{n=1}^{n} AID_{t-n}, PM_t, FXR_t) \quad (9)$$

where

M_t, M_{t-1}	=	commercial imports of food from the United States in time periods t and t-1,
Y_t, Y_{t-1}	=	gross domestic product in time periods t and t-1,
QS_t, QS_{t-1}	=	domestic production of food in time periods t and t-1,
PM_t	=	price of imports in time period t in domestic currency,
FXR_t	=	foreign exchange reserves in time period t, and
AID_t, AID_{t-1}	=	shipments of food aid received in time periods t and t-1.

In this framework, import prices are treated as exogenous, because they are given by world markets or through government policy. Foreign exchange reserves are also treated as exogenous. The remaining variables are treated as endogenous. Variables that measure resource efficiency and export orientation are useful for examining differences in food aid imports across countries, but not for individual country analysis. Note that the exact number of lags to be included in the model (e.g., the value of n in the preceding equations) is at the discretion of the researcher in a VAR model. A separate coefficient is estimated for each lagged value; that is, the term $\Sigma_{n=1}^{n} M_{t-n}$ should not be construed as a single variable that sums up the total value of imports in previous time periods. Thus, if imports lagged three periods are included in the model, separate coefficients for M_{t-1}, M_{t-2}, and M_{t-3} will be estimated. In effect, if a three-period lag were included for each endogenous variable, Equations 6 through 9 would each have 14 variables on the right (12 endogenous and 2 exogenous).

Equations 6 through 9 show that each endogenous variable is determined by past values of itself, past values of the endogenous variables, and current values of the exogenous variables. All the possible interactions among the variables are captured by this model. Vector autoregression models can be viewed as a system of equations in which a number of possible structural models may be explaining the underlying data (Haikko and Morris, 1984). VAR seems most appropriate because it is uncertain how to appropriately capture the "true" structural model linking food aid and commercial food imports.

The preceding VAR model detects the impact of food aid on commercial food imports through its interaction with other variables. For example, food aid has a direct impact not only on imports (Equation 6), but also on income (Equation 7). Because the value of domestic production (QS) is included in the equations, the impact of food aid on production (Equation 8), through its impact on prices and income, is adequately captured in the model. A price variable could be incorporated into the model; however, in order to save on degrees of freedom, this variable has been omitted. In addition, given

the difficulty of obtaining these data, and their lack of reliability, it is not necessary to include a price variable in the equations. Instead, a more direct linkage between food aid and production may be captured by ensuring that food aid is included as an explanatory variable for the production equation (Equation 8). In this approach, the impact of government subsidization or nonsubsidization of food aid commercial sales is not modeled. It is assumed that governments subsidize food aid commercial sales at a constant rate over the time period of the model. Thus, the critical question is "given these marketing systems and institutions, what is the impact of food aid on commercial food imports?"

The impact of an increase in food aid on commercial food imports can be simulated when coefficients for the variables in Equations 6 through 9 have been estimated. To observe the total impact of food aid on commercial food imports, the impact of food aid on all of the endogenous variables must be traced through the moving-average representation of the vector autoregression (Appendix A). One of the advantages of the VAR approach is that Equations 6 through 9 have the same variables on the right. Hence, the equations can be estimated separately with ordinary least squares (OLS). Thus, *t*-statistics can be obtained for each variable. The values for the *t*-statistic for each particular lag of the endogenous variable are not particularly meaningful, given the collinearity that may exist between lagged values of a variable. Collectively, however, the significance of a variable can be assessed by adding the coefficients of all the lagged variables and dividing by the sum of the standard errors of each lagged variable. For example, if income is lagged three periods in Equation 6, the significance of income in affecting imports can be assessed by adding the coefficients of income in periods *t*-1, *t*-2, and *t*-3 and dividing by the sum of the standard errors of each lagged variable.

The difficulty of the VAR technique is determining the lag structure to use for each variable. That is, the model includes lagged values for each variable (AID_{t-1}, AID_{t-2}, etc.), but the model builder must decide the number of lags to choose. For example, in Equation 6, should only values of each variable lagged two periods be included (AID_{t-1}, AID_{t-2}), or should the modeler add the variable AID_{t-3} as well? Whether the econometrician should add additional lagged variables is determined by statistical criteria using chi-squared tests. Basically, lagged variables are added to the system as long as they increase the explanatory power of the model.

One curious aspect of the VAR technique is that contemporaneous endogenous variables are not included on the right of each equation. That is, commercial food imports are not explained by income in period *t*, but through the impact of income in periods *t*-1, *t*-2, and so forth. However, the VAR technique captures the contemporaneous impact of income, but indirectly—through the correlation of error terms across equations. This is best explained in the context of the moving-average representation of the VAR explained in Appendix A. When a time series is modeled as a moving-

average, variations in the series are explained by shocks to or innovations in the error term. As previously mentioned, all the variables in a VAR model are the same on the right of each equation. For Equations 6 and 7, this implies that any error to Equation 6 (for example) will have an impact on the left side variables of Equations 7 through 9. The contemporaneous correlation of income and imports is thus revealed when the VAR model is forecast using the moving-average representation.

A VAR model captures both the short- and long-term impacts of food aid on commercial food imports. Short-term effects cannot be detected by looking directly at the regression equations because only lagged values of the right-side variables are used. However, the moving-average representation of the VAR can show the contemporaneous impact of an increase in food aid on commercial food imports. The moving-average representation can also show the cumulative impact of an increase in food aid, whereby the sum effect of food aid on commercial food imports in periods t, $t+1$, and so forth is calculated. Thus, if food aid has a negative impact on commercial food imports in the immediate period, and positive long-term effects, the moving-average representation will show whether these positive long-term effects outweigh the negative short-term impact.

Chapter 4

A NONECONOMETRIC APPROACH

Introduction

In addition to econometric approaches, a case study approach may provide similar insights. This chapter discusses the relative merits of these two approaches to studying the impact of food aid on imports. The advantage of the econometric approach is that it can help to separate the individual effect of food aid on commercial food imports from the many other factors that affect imports (income, import prices, etc.). An additional advantage of an econometric approach is that it can be generalized to apply to more than one country; whereas a case study approach would not permit generalizations beyond that case study.

Nevertheless, the econometric approach does have weaknesses. For example, although it will convey the patterns revealed in the data, it will not explain why they occurred. Suppose, for example, food aid increases commercial food imports in a certain country in the long term because of its positive impact on savings, investment, and income. Although Granger causality tests can be conducted to show that food aid "causes" income, econometric techniques will not easily reveal the reasons that food aid causes greater income in some countries rather than in others. Thus, a case study approach may be better suited for explaining how food aid was actually used from country to country and how it contributed to or retarded economic development. Perhaps the ideal method would be to (1) run econometric models to pick up any patterns evident in the data, and (2) use selected case studies to analyze why those patterns exist.

Country Study Approach

As discussed above, econometric approaches for analyzing the impact of food aid imports on commercial food imports are useful for estimating the direction and relative size of the impact, but they fail to provide useful policy-level guidance for future food aid programming. Using solely an econometric approach to determine the impact of food aid imports on commercial trade levels cannot include in the analysis important economic variables and the unique role played by government institutions and policies that influence the transformation of food aid into commercial trade of food. Some of these key variables are difficult to incorporate into econometric analysis because they are nonquantifiable or country-specific. Therefore, they are not easily replicated and incorporated into quantitative analysis.

To address these weaknesses in the econometric approaches, it would be useful to conduct country studies as a part of the follow-on econometric analysis. Country case studies will

- Provide valuable country-specific data that are necessary for an econometric study of the transformation of food aid imports into commercial food imports.

- Identify and collect data for important variables to be included in the econometric analysis that would be difficult to obtain and are not available through standard data gathering methods and in standard data sources. Important country-specific variables include domestic consumption, consumer prices, and border prices of important agricultural commodities. These data will be described and analyzed to identify important trends that can reveal how food aid imports influence agricultural production and trade.

- Identify, understand, and incorporate important country-specific economic relationships, such as controlled agricultural markets, into this analysis. Controlled food markets have an important impact on commercial trade that could not be incorporated into the quantitative analysis.

- Describe the local private sector and government institutions that govern food production and pricing to determine how food aid influences agricultural production and commercial food imports and exports.

- Describe the evolution of U.S. commercial agricultural imports.

On the basis of the results of the country case studies, it should be possible to provide additional insights concerning (1) the characteristics of countries

that achieve success and those that fail in transforming their food aid imports into commercial imports with the United States, and (2) ways to strengthen future food aid programming. Key variables that influence changes in commercial imports and that would be examined using a country study approach are discussed next.

1. Agricultural policies are important determinants of commercial trade volumes. Policies that would affect commercial trade levels include (1) the absence or presence of controlled agricultural markets and prices, (2) government subsidization or taxation of the agricultural sector, and (3) government budget expenditures on agriculture (especially relative to other sectors). One analyst modeled India's domestic agricultural market by incorporating variables that represent the country's domestic fair price shops. Using variables representing India's controlled agricultural markets improved the reliability of the results. However, incorporating country-specific variables such as these would prove difficult, if not impossible, without in-depth knowledge of the country and the means to collect the relevant data.

2. Macroeconomic policies and performance. Country studies would examine important macroeconomic policies that affect the development of commercial trade with the United States. Macroeconomic variables such as exchange rates, government budget expenditures, government investment, national savings rates, and trade policies influence the linkages between food aid and commercial trade. It is also desirable to measure the economic efficiency of the country by measuring variables such as capital/output ratios, growth in gross domestic product, and changes in relative contributions to gross domestic product by sector.

   A key variable that controls the level of commercial imports is national income growth. It is assumed that food aid imports promote economic growth in recipient countries. It is also assumed that countries that invest their resources efficiently will invest these additional economic resources made available through food aid shipments in activities for which they have a higher comparative advantage. If, for example, the country has a comparative advantage in industrial production, such a transformation will result in the transfer of resources from agricultural activities into industrial activities, which may be relatively more productive and profitable. Therefore, the demand for agricultural imports will rise in these countries. This paradigm describes a structural transformation that may occur with some food aid recipients, which results in increased commercial trade with the United States. Korea and Taiwan are examples of countries that have accomplished such structural transformation and are significant importers of U.S. food

commodities. By completing country studies, it is possible to determine key factors that allow a food aid recipient country to transform its food aid imports into commercial food imports.

3. **Microeconomic variables.** Domestic prices are critical for determining the long- and short-term impacts of food aid shipments on commercial trade patterns. Important price variables are consumer prices, border prices, and to a lesser extent, world prices. Data series for consumer price variables are all but impossible to locate without conducting a detailed survey of available country studies and papers and by contacting institutions in-country and overseas that conduct economic research on the country.

4. **Noneconomic and institutional considerations.** Noneconomic considerations have an impact on commercial trade patterns (such as preferences and political realities) and are important elements of a study of the linkages between food aid and commercial trade. Such factors include the country's historical patterns of trade with its major trading partners. Countries may select their trading partners for noneconomic or political reasons.

Countries to be Examined Using Country Studies

Detailed studies of four countries are proposed that would represent cases of success and failure for transforming food aid into commercial trade. These countries should be selected on the basis of (1) the size and importance of their historical and current levels of food aid imports, (2) the size and importance of their commercial imports of agricultural products (particularly from the United States), and (3) the results of the econometric analysis. The preliminary results of the econometric analysis would help to identify countries with positive and negative linkages between food aid and commercial trade. Countries characterized by strong results (either positive or negative) could provide insight into the food aid and commercial trade transformation mechanisms. The characteristics or determinants of success for transforming food aid into commercial trade will be identified.

Some likely candidates for success story country studies include Indonesia, Malaysia, Singapore, Korea, Brazil, and Thailand. These countries have been relatively large food aid recipients and currently maintain sizable commercial trade in agricultural commodities with the United States. Also, it is desirable to include two countries that have failed to expand commercial imports from the United States after a history of food aid imports. For example, countries such as Bangladesh, Egypt, Morocco, and Sudan could be candidates.

Approach for Completing Country Studies

The following tasks should be completed for each country included in the country study component.

- A detailed survey and review of available and relevant economic literature.
- In-depth interviews with individuals in both the United States and overseas who have knowledge of key government and private sector institutions that influence the transformation of food aid imports into commercial food imports.
- In-depth interviews with individuals in the United States and overseas who have knowledge of the evolution of U.S. commercial food imports in the study country.
- Identification, collection, and preliminary analysis of relevant data for country-specific variables such as consumer and border prices and agricultural production and trade.

Chapter 5

RECOMMENDATIONS

In light of the alternative modeling techniques described in Chapter 4, this chapter summarizes the reasons why vector autoregression (VAR) is the best technique available for analyzing the impact of food aid on commercial imports. The vector autoregression approach

- Tests the dynamic interactions among the variables that affect imports.
- Contains a separate equation for each endogenous variable and can capture the indirect effects of food aid on imports through the impact of food aid on other variables.
- Captures the dynamic interactions among the endogenous variables that might affect food imports.
- Is feasible to construct because the data requirements can be satisfied.
- Uses software that is user-friendly and that facilitates rapid analysis of the data.

Because vector autoregression is a relatively new technique, some potential concerns about its appropriateness for the research question under consideration should be addressed. First, there is the question of whether VAR models can be used for policy analysis, or to assess the relationship between variables. Vector autoregression models are atheoretical in that they impose no theoretical structure on variables. Rather, VAR models seek to find patterns in past data and examine the dynamic interactions between variables.

The concern that VAR models cannot be used to assess the structural relationship between variables is rooted in the fact that VAR models sometimes include only a small number of variables. Thus, although a VAR model that has only a small number of variables may do a good job of forecasting because of the high correlation between the variables, this high

correlation may be the result of the mutual dependence of these two variables on an omitted variable. In a strict econometric sense, VAR models are often misspecified because they do not include all of the relevant variables that might potentially enter into a structural model. When data are of poor quality (such as price data on commodities in LDCs), or it is difficult to correctly specify the model, then a VAR model may not be any more misspecified than a structural model. This is especially pertinent for this research task, given the difficulty in modeling the impact of government intervention in commodity markets.

In compensating for the risks of misspecification, VARs offer much greater dynamic interaction among variables, and hence may more accurately capture the true relationship between two variables. Monte Carlo experiments reveal that when the structural model is misspecified, VAR models more accurately represent the underlying data (Haikko and Morris, 1984). VARs have been used to assess the relationship between variables; for example, Lavy (1990) used a three-variable VAR to assess the impact of food aid on production and imports, whereas Genberg, Salemi, and Swoboda (1987) used a VAR model to explain the importance of foreign and domestic disturbances in the Swiss economy. More recently, McMillin (1991) used a seven-variable VAR to assess the impact of several different variables to explain changes in the velocity of M1 during the 1980s. Thus, the approach taken here follows that used in recent empirical research that uses VARs to explain the historical relationships between variables.

Estimated Level of Effort to Develop an Econometric Model

The previous chapters in this report support the conclusion that it is possible to develop econometric models that can provide useful and statistically significant information on the impact of food aid on commercial trade in food commodities. In response to specific requests from A.I.D., the level of effort and attendant costs are estimated. To develop a model(s) would require three types of tasks conducted in three phases: (1) econometric modeling, (2) hypothesis testing for differences across countries, and (3) country studies.

Phase I: Econometric Modeling

In order to build econometric models, three tasks must be performed: (1) data preparation, (2) model building and analysis, and (3) report writing. The effort required for data gathering and model building and analysis under the recommended econometric methods outlined in Chapter 3 is addressed next. For vector autoregression modeling, 17 countries are proposed for study: Indonesia, Egypt, the Dominican Republic, India, Pakistan, Peru, Sri Lanka, Sudan, Tunisia, South Korea, Bolivia, Chile, Morocco, Israel, Brazil, Colombia, and Turkey. These countries were chosen because they have sufficiently long

experience with food aid. The estimated time to perform the three tasks required under the vector autoregression model is presented below.

- **Data preparation:** To gather the relevant variables, transform them into real variables in U.S. dollars and prepare them for econometric software, a total of 34 person-days is estimated (allocating 2 person-days per country for 17 countries).

- **Modeling:** Assuming that the VAR model will be estimated for 17 different countries, 40 person-days is estimated for econometric modeling and analysis (60 hours to estimate the model for the first country and 15 hours for each additional country).

- **Report writing:** It is estimated that writing a report that summarizes the econometric results for 17 countries will take 10 person-days.

Phase II: Hypothesis Testing

If the VAR model is used, it will be necessary to complete a second phase of the project in order to determine why the response of commercial food imports to food aid differs among the 17 countries. As mentioned earlier, the goal of this hypothesis testing is to assess whether countries that use their resources more efficiently to achieve economic development objectives and countries that are export-oriented are more responsive to using food aid transfers to expand commercial food imports.

This phase will involve two steps: (1) gathering data for variables measuring efficiency and export orientation (10 person-days), and (2) statistical hypothesis testing (10 person-days).

Phase III: Country Studies

In addition to developing an econometric model to assess the impact of food aid, it is also recommended that four country studies be conducted to provide collaborative or qualitative support to the proposed econometric work. Four countries should be examined, of which two would consist of countries that successfully passed from food aid recipients to commercial importers of food commodities from the United States and two others that have been unsuccessful food aid recipients in this regard. It is estimated that 1.5 person-months per country, including a 3-week field visit, would be necessary to obtain the data for preparing a report on the factors that made food aid programs successful or unsuccessful. A total of 6 person-months are estimated for this phase of the project.

Appendix F contains detailed budget estimates for each model approach and for the hypothesis testing element associated with two of the models. It also contains the country studies budget.

Appendix A

MOVING-AVERAGE REPRESENTATION OF A VECTOR AUTOREGRESSION

The moving-average representation of a vector autoregression (VAR) shows the impact of a shock (innovation) to one variable on the values of the other variables. In the moving-average representation of a time series, changes in the dependent variable are thought to result from shocks to or changes in the error term. Presented in this appendix is a simple two-variable VAR to explain a typical moving-average representation based on the excellent pedagogical exposition by Haikko and Morris (1984).

In this two-variable model, the model is one-period autoregressive, so that

$$x_t = ax_{t-1} + by_{t-1} + u_t \tag{1a}$$

$$y_t = cx_{t-1} + dy_{t-1} - v_t \tag{2a}$$

where

x_t = value of variable x in time period t,
y_t = value of variable y in time period t,
u_t = error term: $E(u_t) = 0$, and
v_t = error term: $E(v_t) = 0$.

To show the impact on y of a change in x, a shock to or innovation on y is introduced. Because the right side of the equation has the same variables for both x and y, the only way to show a shock to y that will affect x is by a change that is not explained by the variables on the right of the equation. In other words, the impact of a change in y on x must be shown through a shock to the error term in Equation 2a. This is precisely what is done through the moving-average representation of the VAR.

The moving-average representation is obtained by explaining variations in each variable by changes in the error terms, so that in each equation the terms are rearranged terms and the appropriate values substituted. This results in

$$x_t = u_t + u_{t-1} + (a^2 + bc)u_{t-2} + \ldots bv_{t-1} + (ab + bd)v_{t-2} \quad (4a)$$

$$y_t = cu_{t-1} + (ac + cd)u_{t-2} + vt + (bc + d^2)v_{t-2} \ldots \quad (5a)$$

Let us consider the impact on x of an innovation on y. If v_t is increased by a unit, then y_t increases by a unit. In addition, if v_t and u_t are correlated, then a change in v_t will cause u_t to change; hence, x_t. Assume, for simplicity that $d = 1$ and the correlation coefficient between the two is denoted as r. In this case an increase in v_t will increase u_t by r and x_t will increase by r. Thus, because u_t and v_t are contemporaneously correlated, changes in x_t cannot be solely attributed to changes in u_t; changes in v_t (through their impact on u_t) can also affect x_t.

In this context it can be seen that contemporaneous values of the endogenous variables in a VAR model can be omitted. In our model this implies that if income affects imports, the current value of income need not be included as an additional variable on the right of the equations. Any change in income that is not explained by the lagged values of the right-side variables will be captured in the error term; and given that the error term in the income equation is correlated with that in the import equation, the model captures the impact of changes in income in period t on imports in the same time period.

Before the moving-average representation is explained, it is necessary to digress and introduce matrix H, where

$$H = \begin{bmatrix} 1 & 0 \\ \frac{-r}{\sqrt{1-r^2}} & \frac{1}{\sqrt{1-r^2}} \end{bmatrix} \quad (6a)$$

Following Haikko and Morris (1984), $e1_t$ and $e2_t$ are formed, where

$$\begin{matrix} e1_t \\ e2_t \end{matrix} = H \begin{bmatrix} u_t \\ v_t \end{bmatrix} \quad (7a)$$

We can now calculate x_t and y_t as

$$x_t = ax_{t-1} + by_{t-1} + e1_t \tag{8a}$$

$$y_t = rx_t + (c - ra)x_{t-1} + (d - rb)y_{t-1} + \sqrt{1 - r^2}e2_t \tag{9a}$$

$$e1_t = u_t \tag{10a}$$

$$e2_t = (-ru_t + v_t) / \sqrt{1 - r^2} \tag{11a}$$

Note that in this system, the error terms $e1_t$ and $e2_t$ are independent. However, an innovation in $e1_t$ will have no effect on $e2_t$ but will have an effect on y_t.

The moving-average representation of these equations is given by

$$\begin{aligned} x_t = {} & e1_t + (a + br)e_{t-1} + [a^2 + bc + br(a + d)]e1_{t-2} + \ldots \\ & + b(\sqrt{1 - r^2})e2_{t-1} + b(a + d)(\sqrt{1 - r^2})e2_{t-2} + \ldots \end{aligned} \tag{12a}$$

$$\begin{aligned} y_t = {} & re1_t + (c + dr)e1_{t-1} + [c(a + d) + r(bc + d^2)e1_{t-2} + \ldots \\ & + (\sqrt{1 - r^2})e2_t + d(\sqrt{1 - r^2})e2_{t-1} + (bc + d^2)(\sqrt{1 - r^2})e2_{t-2} + \ldots \end{aligned} \tag{13a}$$

These equations show that an increase in e1 increases x by 1 unit and y by r units, because e1 is the right-side variable of y_t.

The moving-average interpretation of the VAR permits tracing of the impact of a change in one of the variables on the other variables. The shock or innovation to the variable is shown by a change in $e1_t$ or $e2_t$. With this system of equations (Equations 6-9), a shock to the error term for the variable AID is simulated in Equation 9. In effect, the impact of a unit increase in food aid on all the other variables is simulated. Working through the dynamic effects over time, the total impact of a unit increase in food aid on imports can be assessed.

The impact of an increase in aid on imports is traced through all the equations with an "impulse response function" based on the moving-average representation of the VAR. The impulse response function can be used to quantify the cumulative effect of a unit increase in aid on imports over a specified time period. The degree to which food aid helps to explain variations in imports is also reported through the decomposition of variance.

Appendix B

A POOLED VECTOR AUTOREGRESSIVE MODEL OF FOOD AID AND COMMERCIAL FOOD IMPORTS FROM THE UNITED STATES

Model

Given the short time series available for data describing U.S. food exports to particular countries, data must be pooled to form an econometric model. The methodology described below for a pooled VAR model follows Lavy (1990).

The proposed model is as follows:

$$(M_t - M_{t-1}) = f[(\Sigma_{n=1}^{n} M_{t-n} - M_{t-2-1}), (\Sigma_{n=1}^{n} Y_{t-n} - Y_{t-2-1}), (\Sigma_{n=1}^{n} QS_{t-n} - QS_{t-n-1}), (\Sigma_{n=1}^{n} AID_{t-n} - AID_{t-n-1}), (PM_t - PM_{t-1}), (FXR_t - FXR_{t-1}), (R_t - R_{t-1})] \quad (1b)$$

$$(Y_t - Y_{t-1}) = f[(\Sigma_{n=1}^{n} M_{t-n} - M_{t-n-1}), (\Sigma_{n=1}^{n} Y_{t-n} - Y_{t-n-1}), (\Sigma_{n=1}^{n} QS_{t-n} - QS_{t-n-1}), (\Sigma_{n=1}^{n} AID_{t-n} - AID_{t-n-1}), (PM_t - PM_{t-1}), (FXR_t - FXR_{t-1}), (R_t - R_{t-1})] \quad (2b)$$

$$(QS_t - QS_{t-1}) = f[(\Sigma_{n=1}^{n} M_{t-n} - M_{t-n-1}), (\Sigma_{n=1}^{n} Y_{t-n} - Y_{t-n-1}), (\Sigma_{n=1}^{n} QS_{t-n} - QS_{t-n-1}), (\Sigma_{n=1}^{n} AID_{t-n} - AID_{t-n-1}), (PM_t - PM_{t-1}), (FXR_t - FXR_{t-1}), (R_t - R_{t-1})] \quad (3b)$$

$$(AID_t - AID_{t-1}) = f[(\Sigma_{n=1}^{n} M_{t-n} - M_{t-n-1}), (\Sigma_{n=1}^{n} Y_{t-n} - Y_{t-n-1}), (\Sigma_{n=1}^{n} QS_{t-n} - QS_{t-n-1}), (\Sigma_{n=1}^{n} AID_{t-n} - AID_{t-n-1}), (PM_t - PM_{t-1}), (FXR_t - FXR_{t-1}), (R_t - R_{t-1})] \quad (4b)$$

where

M_t, M_{t-1}	=	commercial imports of food from the United States in time periods t and t-1,
Y_t, Y_{t-1}	=	gross domestic product in time periods t and t-1,
QS_t, QS_{t-1}	=	domestic production of food in time periods t and t-1,
PM_t	=	price of food imports from the United States in time period t in domestic currency,
FXR_t	=	foreign exchange reserves in time period t,
R_t	=	exchange rate of U.S. dollar compared with that of other food exporters, and
AID_t, AID_{t-1}	=	shipments of food aid received in time periods t and t-1.

In this framework, import prices are treated as exogenous because they are given either by world markets or through government policy. Foreign exchange reserves are also treated as exogenous. The U.S. exchange rate, compared with a weighted basket of the currencies of these exporting nations, is included as a measure of the price competitiveness of U.S. food products with respect to other food exporters. The remaining variables are treated as endogenous. Note that the exact number of lags to be included in the model (e.g., the value of n in the preceding equations) is at the discretion of the researcher in a VAR model. A separate coefficient is estimated for each lagged value; that is, the term ($\Sigma_{n=1}^{n}$ $M_{t-n} - M_{t-n-1}$) should not be construed as a single variable that sums up the total value of imports in previous time periods. Thus, if imports lagged three periods are included in the model, separate coefficients for ($M_{t-1} - M_{t-2}$), ($M_{t-2} - M_{t-3}$), and ($M_{t-3} - M_{t-4}$) will be estimated. In effect, if a three-period lag were included for each endogenous variable, Equations 1b-4b would each have 15 variables on the right (12 endogenous and 3 exogenous).

Note that the model above uses differenced values, rather than the actual values of the variables alone. This is because pooled data are used. Instead of adding dummy variables for each country, individual country differences are eliminated by using differenced values. Hence, instead of M_t, the variable measured is ($M_t - M_{t-1}$). The model is therefore designed to show the impact of changes in the rate of growth of food aid on the rate of growth of commercial imports from the United States. This is somewhat different from the design of the model when the values of the variables in

levels were used, rather than differenced values. With variables measured in levels (that is, their actual values), the impact of changes in the level of aid on the level of imports is assess. Using differenced values allows examination of changes in the rate of growth of aid on the rate of growth of imports.

By using differenced values, individual country differences disappear. This can be seen by considering what happens when the first difference for a model using levels is taken and a dummy variable is incorporated for each country. The first difference for the country dummy is 0, because as a country dummy it is a constant. One drawback to this approach is that with the dummy variable dropped out, one is forced to assume that there are no country differences in how the variables interact with each other. We have little option but to accept this assumption in the current context; as Lavy (1990) pointed out, separate dummy variables for individual country differences cannot be retained in a model that has lagged endogenous variables.

The four equations given earlier show that each endogenous variable is determined by past values of itself, past values of the endogenous variables, and current values of the exogenous variables. All the possible interactions among the variables are captured by this model. Vector autoregression models can be viewed as a system of equations in which a number of possible structural models may be explaining the underlying data (Haikko and Morris 1984). VAR seems most appropriate for our research tasks because we are uncertain about how to appropriately capture the "true" structural model linking aid and imports.

The preceding VAR model permits observation of the impact of food aid on commercial food imports through its interaction with other variables. For example, food aid has a direct impact not only on imports (Equation 1b), but also on income (Equation 2b). Because the value of domestic production (QS) is included in our equations, the impact of food aid on production (Equation 3b), through its impact on prices and income, is adequately captured in our model. A price variable could be incorporated into the model; however, in order to save on degrees of freedom, this variable is omitted. In addition, given the difficulty of obtaining these price data and their lack of reliability, we believe that it is unnecessary to include a price variable in the equations. Instead, we capture a more direct linkage between food aid and production by ensuring that aid is included as an explanatory variable for the production equation (Equation 3b).

The impact of an increase in food aid on commercial food imports can be simulated when coefficients for the variables in Equations 1b-4b are estimated. To observe the total impact of aid on imports, the impact of aid on all of the endogenous variables must be traced. The change in aid on imports can be simulated by using the "moving-average representation" of the vector autoregression (Appendix A).

One of the advantages of the VAR approach is that each of the four equations 1b-4b has the same variables on the right. Hence, the equations can be estimated separately with ordinary least squares (OLS). In addition, *t*-statistics can be obtained for each variable. The values for the *t*-statistic for each particular lag of the endogenous variable are not particularly meaningful, given the collinearity that may exist between lagged values of a variable. Collectively, however, the significance of a variable can be assessed by adding the coefficients of all the lagged variables and dividing by the sum of the standard errors of each lagged variable. For example, if income is lagged three periods in Equation 1b, the significance of income in affecting imports can be assessed by adding the coefficients of income in periods t-1, t-2, and t-3 and dividing by the sum of the standard errors of each lagged variable.

One curious aspect of the VAR technique is that contemporaneous (same time period) endogenous variables are not included on the right of each equation. That is, imports are not explained by income in period t, but by the impact of income in periods t-1, t-2, and so on. However, the VAR technique does capture the contemporaneous impact of income, but in an indirect way—through the correlation of error terms across equations. This is best explained in the context of the moving-average representation of the VAR explained in Appendix A. When a time series is modeled as a moving average, variations in the series can be explained by shocks to or "innovations" in the error term. As previously mentioned, all the variables in a VAR model are the same on the right of the equation. For Equations 1b and 2b, this implies that any error in measuring income with past values of income and the other variables on the right as a result of this innovation is also likely to show up in Equation 1b, because both equations have the same explanatory variables (right side). The contemporaneous correlation of income and imports is thus revealed when the VAR model is forecast using the moving-average representation. Appendix A elaborates on the moving-average representation and how it shows contemporaneous correlation among endogenous variables.

Thus, a VAR model is able to capture both the short- and long-term impact of food aid on commercial food imports. Short-term (immediate period) effects cannot be detected by looking directly at the regression equations, because only lagged values of the variables on the right were used. However, the moving-average representation of the VAR can show the contemporaneous impact of an increase in food aid on imports. The moving-average representation can also show the cumulative effect of an increase in food aid, whereby the sum effect of aid on imports in periods t, t+1, and so on is calculated. Thus, if food aid has a negative impact on imports in the immediate period but positive long-term effects, the moving-average representation will show whether these positive long-term effects outweigh the negative short-term impact.

Appendix C

DATA AVAILABILITY

Table C-1. Summary of P.L. 480 Data Availability for Recipient Countries

Country	Years of Partici-pation	No. of Observa-tions	Major Program Commodities (years of trade)	Total Value of Title I ($000)
Bangladesh	1974-88	14	Cotton (78-88), rice (75-87), soybean oil (74-88), wheat (74-88)	1,159,245
Bolivia	1962-88	26	Wheat (63-88), wheat flour (62-72)	243,426
Brazil	1956-72	18	Wheat (56-72)	606,583
Chile	1955-76	21	Wheat (56-76)	238,826
Colombia	1956-74	18	Soybean oil (58-68), tobacco (58-73), wheat (56-74)	110,067
Domin. Rep.	1963-88	25	Corn (68-84), rice (63-87), soy oil (68-88), wheat (66-88)	259,410
Egypt	1956-88	32	Corn (60-81), tobacco (60-77), wheat (56-88), flour (59-88)	3,609,980
El Salvador	1980-88	8	Wheat (80-88 and 62)	291,205
Haiti	1975-88	13	Rice (77-81), soybean oil (77-87), wheat (75-87)	115,357
Honduras	1975-88	13	Wheat (75-88)	92,436
India	1957-88	31	Corn (59-68), cotton (57-72), rice (57-76), soy (61-78), wheat (57-77)	4,479,202
Indonesia	1956-88	33	Cotton (57-76), rice (57-84), wheat (72-88)	1,668,675
Israel	1955-80	25	Corn (57-80) sorghum (55-74) soy oil (58-74) tobacco & wheat (55-74)	645,391
Jordan	1966-79	13	Wheat (66-79)	58,990
Korea	1955-81	26	Corn (56-80), cotton (55-81), rice (56-77), wheat (55-81)	1,579,566
Morocco	1962-88	26	Wheat (62-88)	493,409
Pakistan	1955-88	33	Cotton (56-73), soybean oil (58-88), tobacco (55-73), wheat (57-79)	2,203,487
Peru	1955-88	33	Rice (58-88), wheat (55-88)	254,793
Sri Lanka	1959-88	29	Wheat (72-88), wheat flour (59-79)	424,308
Sudan	1962-88	26	Wheat (63-88)	423,393
Tunisia	1962-88	26	Corn (62-88), soybean oil (63-83), wheat (62-88)	319,392
Turkey	1955-72	17	Cottonseed oil (55-65), wheat (55-72)	550,104

Source: Economic Research Service, U.S. Department of Agriculture.

Table C-2. Years of Availability of Economic Data for P.L. 480 Recipient Countries

Country	GDP	Population	Exchange Rates
Bangladesh	1973-present	1972-present	1971-present
Bolivia	1960-present	1950-present	1977-present
Brazil	1958-present	1950-present	1950-present
Chile	1966-1986	1950-present	1960-present
Colombia	1950-present	1950-present	1950-present
Dominican Republic	1950-present	1950-present	1950-present
Egypt	1960-1987	1950-present	1950-present
El Salvador	1960-present	1950-present	1950-present
Haiti	1960-present	1950-present	1950-present
Honduras	1950-1987	1950-present	1950-present
India	1950-1987	1950-present	1950-present
Indonesia	1961-1987	1950-1987	1967-present
Israel	1969-1987	1950-present	1974-present
Jordan	1960-1987	1950-1987	1950-present
Korea	1960-1987	1950-present	1950-present
Morocco	1960-1986	1950-present	1950-present
Pakistan	1960-present	1950-present	1950-present
Peru	1960-1985	1950-present	1950-present
Sri Lanka	1950-1987	1950-present	1950-present
Sudan	1960-1987	1950-1987	1950-present
Tunisia	1960-present	1950-present	1950-present
Turkey	1960-1986	1950-present	1950-present

Source: International Financial Statistics, International Monetary Fund.

Appendix D

SCOPE OF WORK

ATTACHMENT A

STATEMENT OF WORK
for
Feasibility of Developing an Econometric Model of the Long-term Relationship Between Food Aid and Commercial Food Imports

BACKGROUND

The 1989 FVA Bureau review of the evaluation literature on program food aid identified a number of gaps in current understanding of food aid and its impact on development. In particular, the study pointed up the need for better information on the relationships among food aid, commercial food imports, and domestic production, over both the short and long term.

A subsequent FVA study in 1990 reviewed the existing body of econometric literature to summarize the empirical results of studies conducted to date on these relationships, and categorized the body of work according to analytical technique, country/region and time period covered, and issues addressed by the econometric analyses. In summarizing the analyses carried out to date, the 1990 study underscored the need to take a multi-country perspective. It suggested that a more comprehensive a model relating food aid shipments to commercial food imports might be feasible which will use data from a cross-section of recipients of food aid, both current and past, and incorporate information on trade, production, and (if possible) non-commercial food distribution channels, in order to draw a more complete and reliable picture of food aid/trade relationships. The study pointed up in particular the absence of information on the long-term market development impacts of food assistance.

Better evidence on these relationships is crucial to determining the extent to which such aid substitutes for commercial imports and/or domestic production in the short term and its relationship to the evolution of commercial markets for the same and related commodities over time. Whether food aid results in greater food availability for recipient country residents and whether food aid helps expand export markets for U.S. agricultural commodities are critical policy issues in the debate over proposed reforms in the food aid legislation.

ARTICLE I – TITLE

Name: Feasibility of Developing an Econometric Model of the Long-term Relationship Between Food Aid and Commercial Food Imports.

Number: 938-0800

ARTICLE II – OBJECTIVE

Determine whether it is feasible to develop an econometric model that estimates the relationship between food aid from specific donors to specific recipient countries, especially the United States food aid, and that country's commercial imports of food from the same donor, over the long term.

ARTICLE III – STATEMENT OF WORK

Feasibility will depend on whether it is possible to develop hypotheses that can distinguish the impact of food aid on commercial food imports from that of numerous other possible causes, such as income growth; whether the hypotheses can be expressed in the form of an econometric models; and whether data is available to test the hypotheses.

Therefore, the study will involve three steps. First, the contractor will formulate one or more hypotheses regarding the causal relationship between food aid and commercial imports, based on the results of the earlier literature review. Second, the contractor will express the hypotheses in the form of econometric equations. Third, the contractor will identify potential data sources and determine whether adequate data can be obtained to test the hypotheses econometrically.

In determing whether a quantitative approach is feasible, the contractor should take into account data availability on commercial import levels (by origen and destination country), domestic prices and production levels of the imported commodities, and food aid levels by origen and destination country. The contractor should assess the suitability of available data for the proposed research in terms of time period covered, comparability across countries, reliability, etc.

If a quantitative approach is deemed feasible, the contractor should consider the following questions when outlining appropriate methodologies for future analysis:

- Should the analysis be carried out on a country-by-country basis or should data from a number of countries be combined?

- How should project and emergency food aid be treated?

- What time period should be used for the analysis?

- How should the model structure used to estimate the long-term relationship between food aid and commercial imports differ from the model used to estimate the short-term relationship?

- What other variables should be included (time frame, population, income growth, agricultural/non-agricultural exports, non-food imprts, non-food agricultural production) in the context of available data and statistical degrees of freedom?

- Should commodities be treated individually (wheat, rice, sorghum, corn etc.) or all together, and how should cross-commodity effects be dealt with?

- Should commodity levels be measured in volume or value terms?

- Should international ordomestic prices be included as a variable? If the latter, what data source should be used?

- How should the regression equations be specified when relating commercial imports, domestic production and food aid?

- Which variables should be lagged and by how much?

- Which dumy variables, if any, should be included?

- Should data be analyszed lonngitudinally, in cross-section, or both?

ARTICLE IV - REPORTS

Intermediate Reports

1) A workplan will be presented to the Project Officer within 15 days of the start-up date.

2) A draft report will be submitted to the Project Officer within two months of the start-up date.

Final Report

1) The Final Report will first conclude whether or not an econometric study of the subject relationship is feasible. If it is deemed feasible, the report will specify the hypotheses, express them in econometric form, identify the sources of data

to be used and outline a workplan for implementing and testing the econometric model (but implementation and testing will not be carried out under this contract). The Report will include an executive summary, thorough footnoting throughout the text and a complete bibliography of all the documents reviewed. Ten copies will be delivered to A.I.D. within three months of the start-up date.

2) An oral briefing on the final study results will be presented for interested A.I.D. personnel at that time.

ARTICLE V - RELATIONSHIPS AND RESPONSIBILITIES

1) The contractor will present all written workplans and reports to the FVA Bureau Project Officer, Jerre Manarolla, Program Economist for FVA/PPM/PAD. Mr. Manarolla is located in room 329, SA - 8 and can be reached at (703) 875-4568.

2) Contractor presentation of the work plan within 15 days of the start-up date will offer A.I.D. the opportunity to ensure that the study focuses on A.I.D. priority issues.

3) Contractor submission of the draft reports will offer A.I.D. staff another opportunity to redirect the study.

ARTICLE VI - PERFORMANCE PERIOD

The contractor will begin the study on or about September 1, 1990. The contractor will complete and deliver the final report to A.I.D. on or about December 31, 1990.

ARTICLE VII - LEVEL OF EFFORT

Approximately 30 person-days time of senior level staff with specialized knowledge of international food trade and econometric methods and 20 days of junior level staff will be required to complete the proposed study. The team should consist of 3 individuals:

project manager	10 days
econometric/trade specialist	30 days
research assistant	25 days

Appendix E

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Appendix F

BUDGET ESTIMATES FOR FOLLOW-ON WORK

Budget 1. VAR Model Approach

Description	Daily Salary	Mult.	Fixed Daily Salary	Total Days	Total
Labor Costs					
A. Model Development					
Project Manager	300	2.2	660	4	2640
Econometrician	200	1.6	320	40	12800
Research Analyst	130	2.2	286	34	9724
Computer Specialist	150	2.2	330	10	3300
Typist	100	2.2	220	10	2200
B. Hypothesis Testing/Report Writing					
Project Manager	300	2.2	660	1	660
Econometrician	200	1.6	320	15	4800
Research Analyst	130	2.2	286	15	4290
Computer Specialist	150	2.2	330	2	660
Typist	100	2.2	220	5	1100
Subtotal, Labor Costs					42174

Other Direct Costs	Unit Price	Unit Type	Units	
Airfares	400	Trip	4	1600
Per Diem	127	Day	4	508
Ground Transportation	10	Day	20	200
Communications	100	Week	10	1200
Xeroxing	150	Week	10	1800
Couriers and Postage	50	Week	10	600
Total, Other Direct Costs				5908
Total Project Costs				48,082

Budget 2. Case Study Approach 1/

Description	Daily Salary	Mult.	Fixed Daily Salary	Total Days	Total
Labor Costs					
Project Manager	300	2.2	660	3	1980
Research Analyst	145	2.2	319	140	44660
Typist	100	2.2	220	8	1760
Subtotal, Labor Costs					48400
Direct Costs	**Unit Price**	**Unit Type**	**Units**		
A. Travel Expenses					
Airfares	2700	Trip	4		10800
Per Diem	125	Day	92		11500
Ground Transportation	20	Day	84		1680
Prep. and Enroute Allowance	150	Trip	8		1200
SOS and DBA Insurance	15	Week	12		90
DBA Insurance					200
B. Other Expenses					
Communications	100	Week	12		1200
Photocopies	150	Week	12		1800
Couriers and Postage	100	Week	12		1200
Total Direct Costs					29670
Total Project Costs					78,070

1/ Note that this estimate is for four country studies.